The Climate Action Project Research Initiative

Bill Stanley
Principal Investigator

The Nature Conservancy

The Climate Action Project Research Initiative

A Cooperative Agreement between the National Energy Technology Laboratory and The Nature Conservancy in collaboration with the Winrock International Institute for Agricultural Development, The Society for Wildlife Research (SPVS), Programme for Belize, Comite de Defensa de la Fauna y Flora (CODEFF), Los Alamos National Laboratory, Trexler and Associates, Colorado State University, and Virginia Tech University.

With Additional Support From: American Electric Power, General Motors, Texaco


The Guaraquecaba Climate Action Project, Brazil

Reforestation at Guaraquecaba

Overview

- Research Goal and Objectives
- Overview of Tasks
- Conclusion

Overall Project Goal

- To improve the planning, design, and implementation of carbon sequestration projects, and to standardize approaches as appropriate.

Project Objectives

- Improve and Lower the Costs of Carbon Inventories (Tasks 1 and 2)

- Refine and Standardize Carbon Inventory and Baseline Approaches to Estimate Offsets (Tasks 3 and 4)

- Assess Feasibility of Implementing New Project Ideas (Tasks 5 and 6)

Task 1

- Carbon Inventory Advancements
  - To improve allometric regressions.
  - To improve and lower the costs of soil carbon measurement.
  - To cost-effectively and accurately establish permanent plots to calibrate advanced videography.
  - Work done in Brazil and Belize.

Improve Carbon Inventories

- Methods use well-established science (e.g. forest mensuration, soil science, ecological surveys).

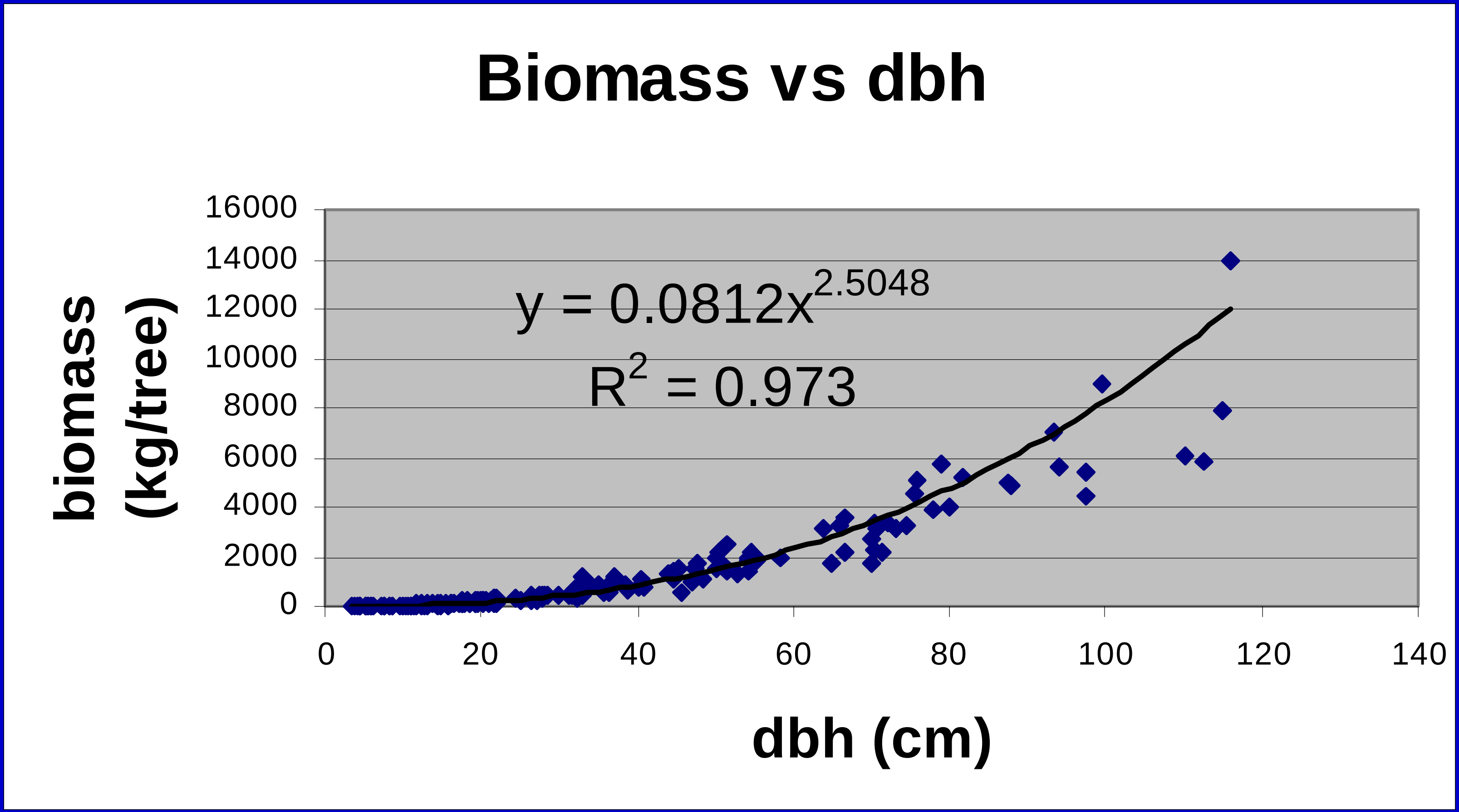
- However, we could improve estimates for some pools, particularly large trees and soils [and roots].

TASK 1

Sources of Error

- Sampling error—e.g. insufficient number and selection of plots to represent the population of interest
- Measurement error —e.g. errors in field measurements of tree diameters, laboratory analysis of soil samples
- Regression error — e.g. based on use of imperfect regression equations to convert diameters to biomass, for example

Improve Carbon Inventories
Strengthen the Regressions



TASK 1

Since data for larger trees are few, additional destructive sampling is needed to build confidence in the regressions. After taking diameter, crown width, and height measurements from the ground, trees are harvested and prepared for weighing.

TASK 1

Bundling branches to prepare them for weighing on a field scale.

Apply the Regressions in Inventory Plots

Measuring aboveground biomass carbon within the boundaries of the permanent plot.

TASK 1

Measuring Major Pools – Soil

- Collect several soil samples (to 30 cm depth) in each permanent plot
- Time consuming and expensive because of laboratory work
- Difficult to take enough samples to reduce sampling error to an acceptable level

Testing A New Soil Measurement Technology

- Laser-Induced Breakdown Spectroscopy (LIBS) could allow for more soil carbon measurements quickly (reduces sampling error)
- Not yet field-ready
- Bulk density samples would still be necessary
- Need to assess difference in costs

Task 2

- Advanced Videography
  - To improve stratification.
  - To estimate carbon storage with greater precision (lower sampling error) and lower cost.
  - Work in Brazil and Belize.

The dual camera videography includes a digital gyroscope and pulse laser along with dual videos, fly video transects and construct georeferenced mosaics. The system fits on the side of any small aircraft.

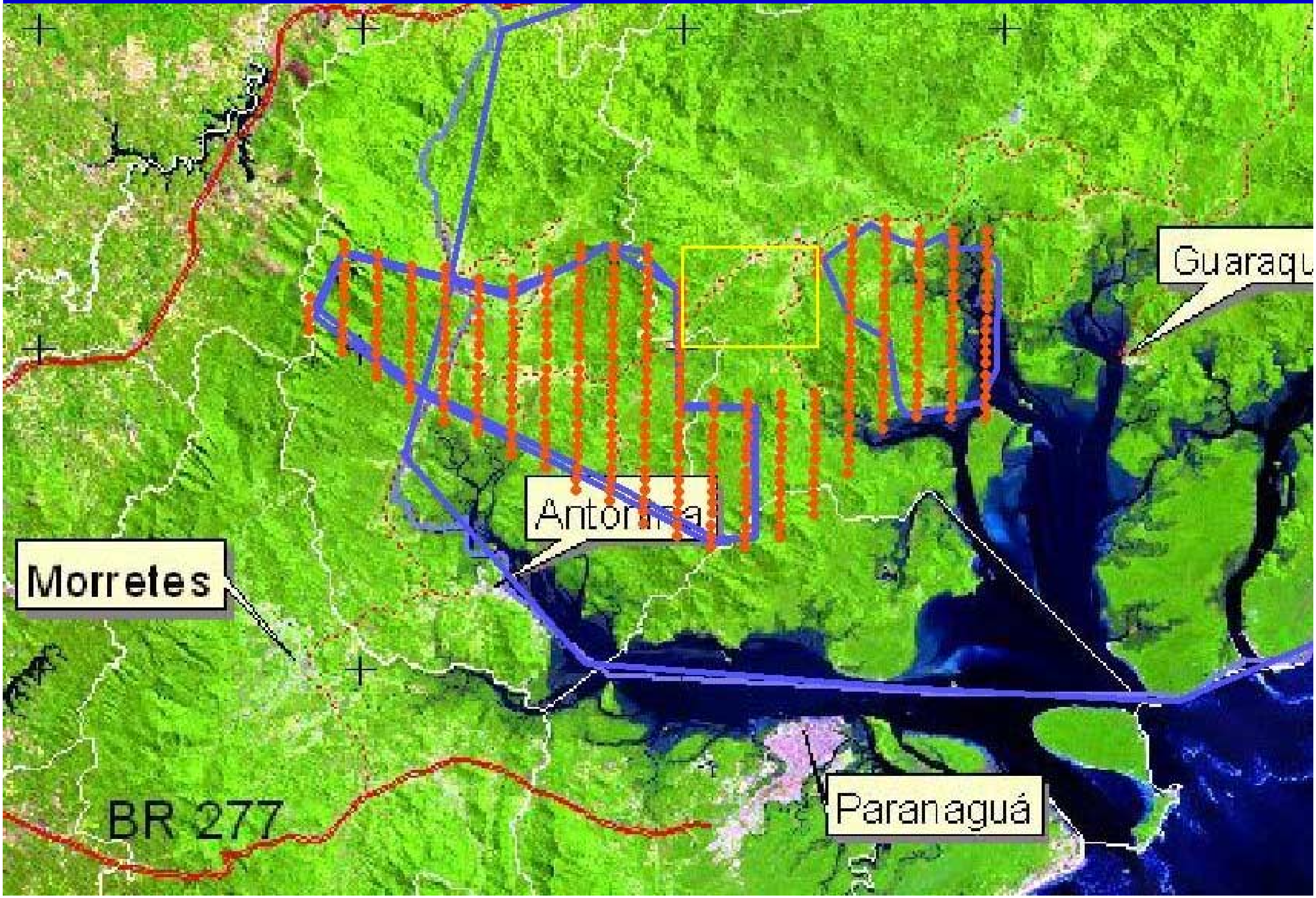
TASK 2

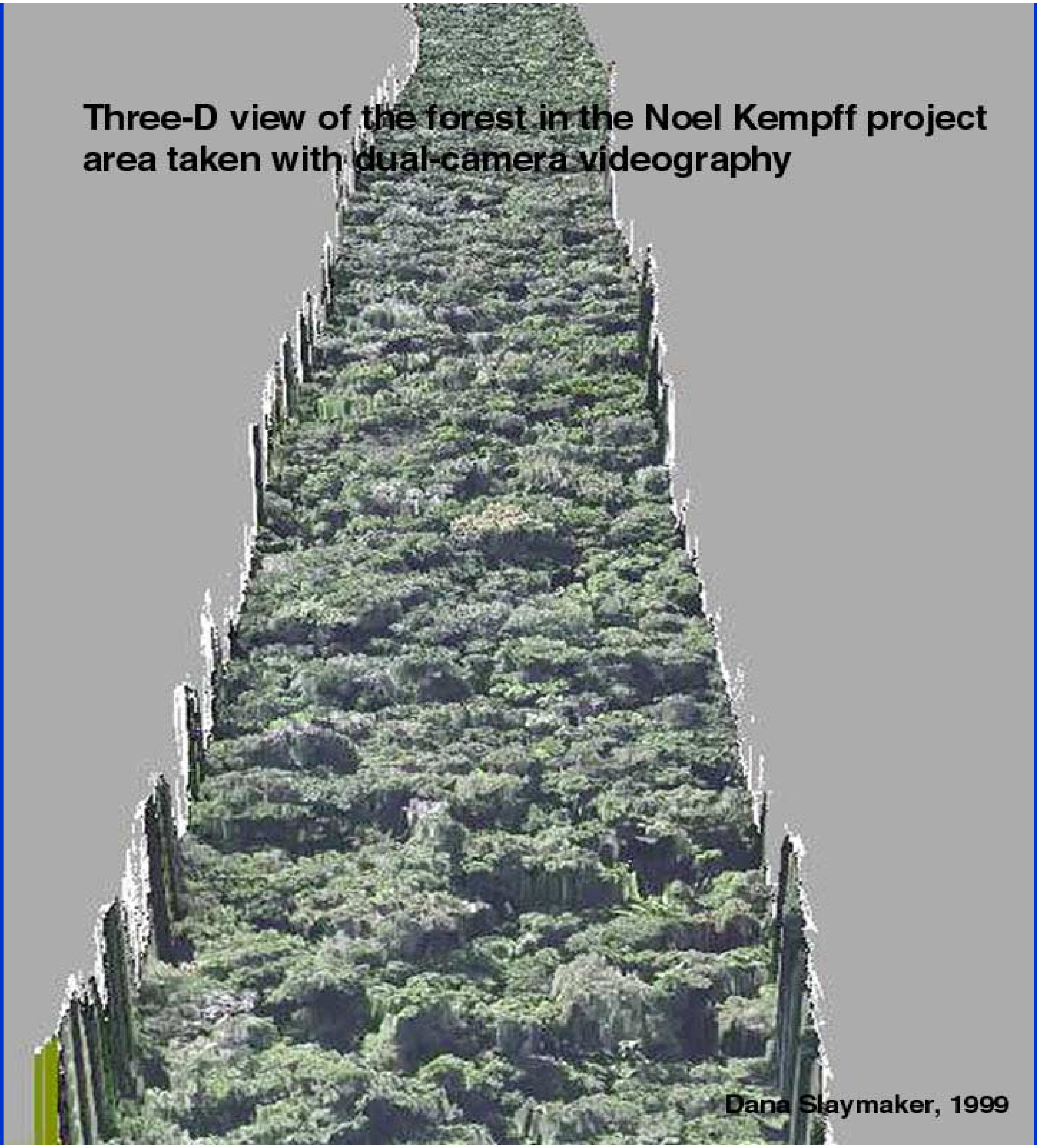
Videography

- Fly aerial transects, GPS located and digitally recorded
- Aerial photography or videography
- Generate georeferenced 2D mosaics or 3D terrains

TASK 2

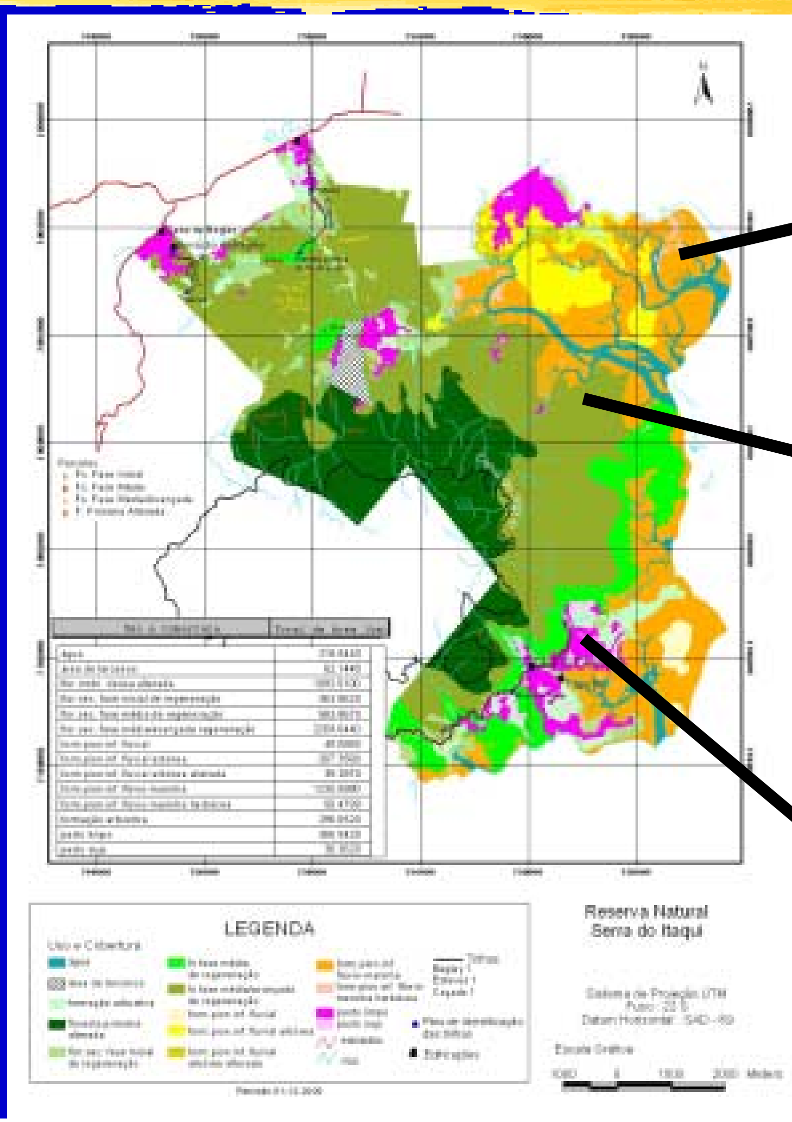
Anticipated flight lines for work planned in Brazil.

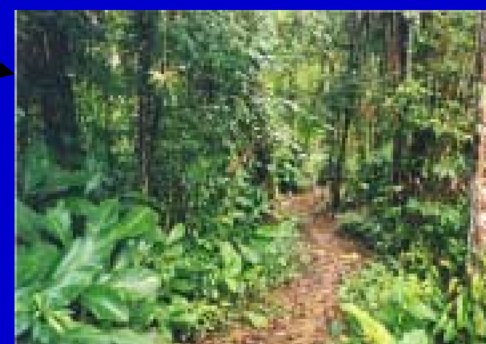



Three-D view of the forest in the Noel Kempff project area taken with dual-camera videography
Dana Slaymaker, 1999

TASK 2

Stratification - Vegetation Map

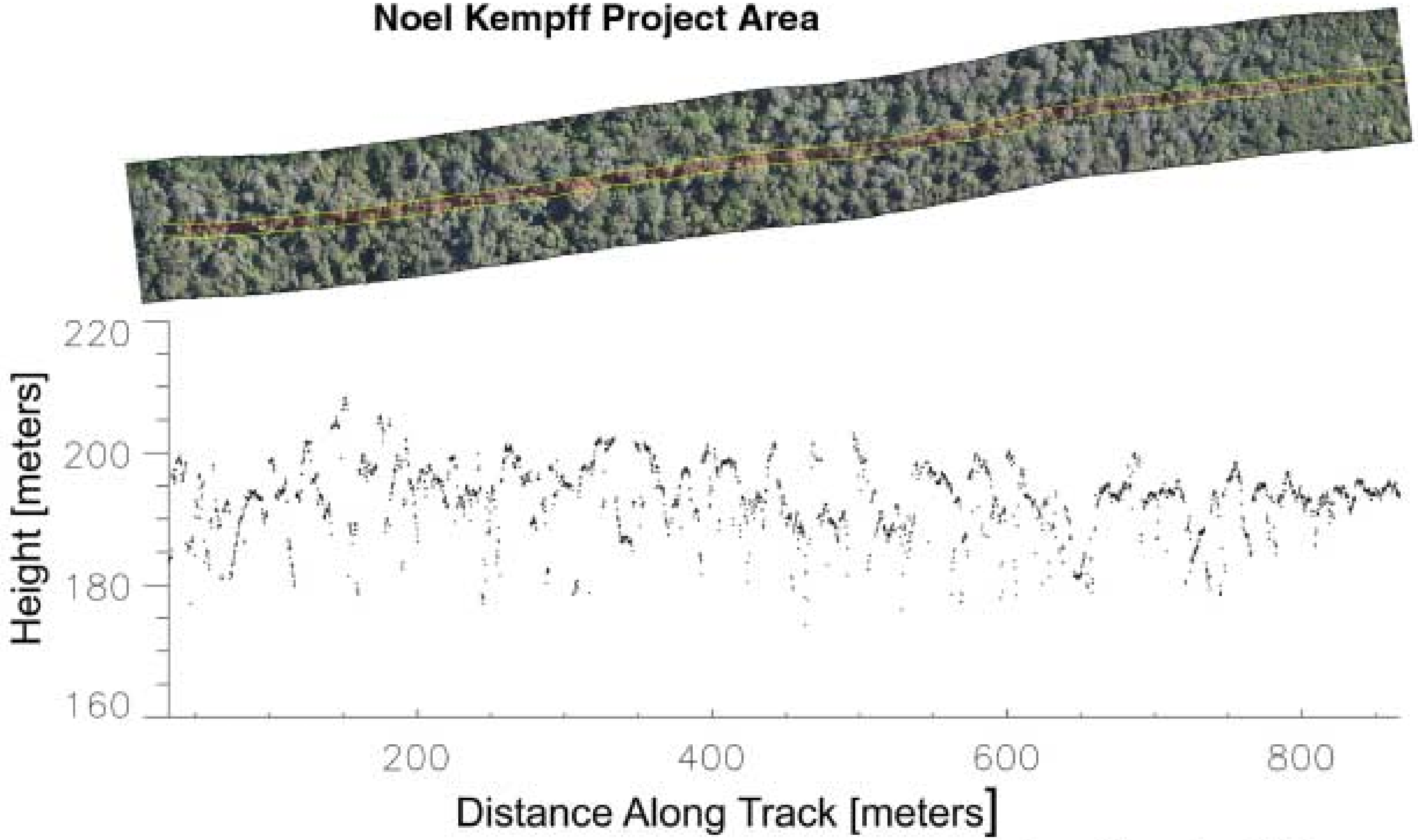




TASK 2

Laser Altimeter Profile

Noel Kempff Project Area

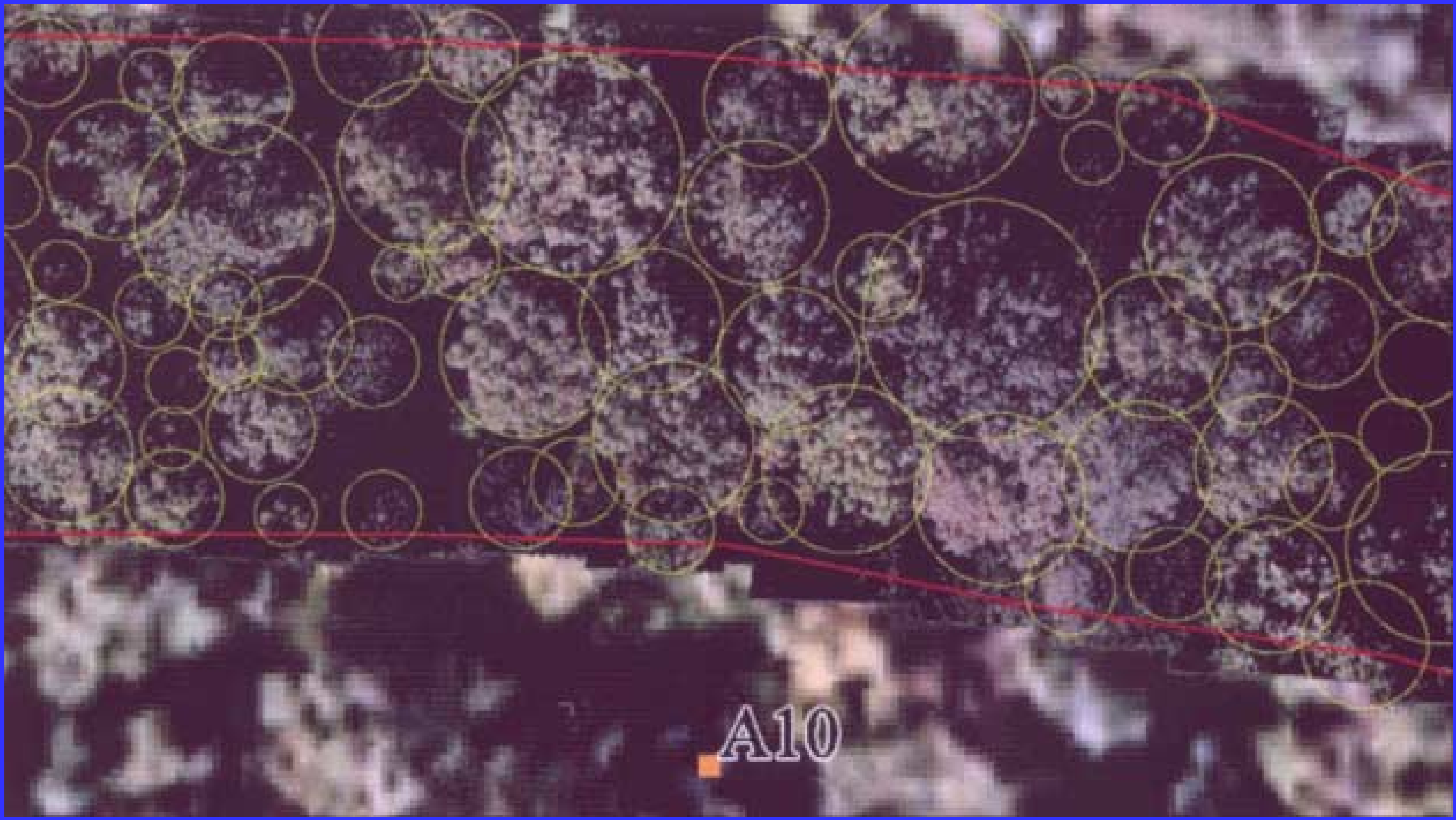


Dana Slaymaker, 1999

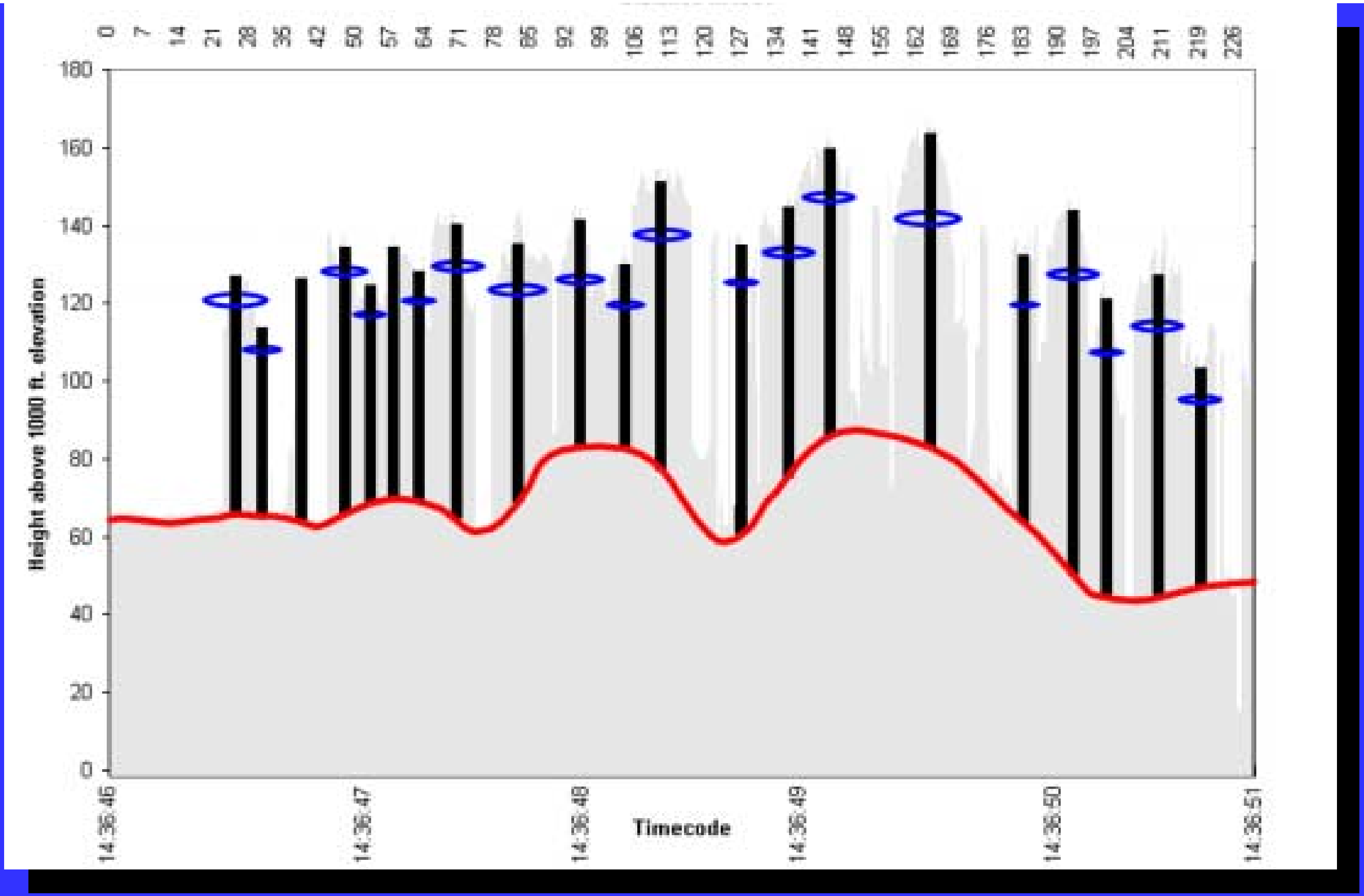
TASK 2

Dual Camera Videography

Identify crowns and measure their diameter and area



TASK 2



Data are used from the 3D reconstruction and the laser profiles to create a simple forest model of number, height, and crown diameter of trees that can be used with allometric regression equations to estimate biomass of the forest.

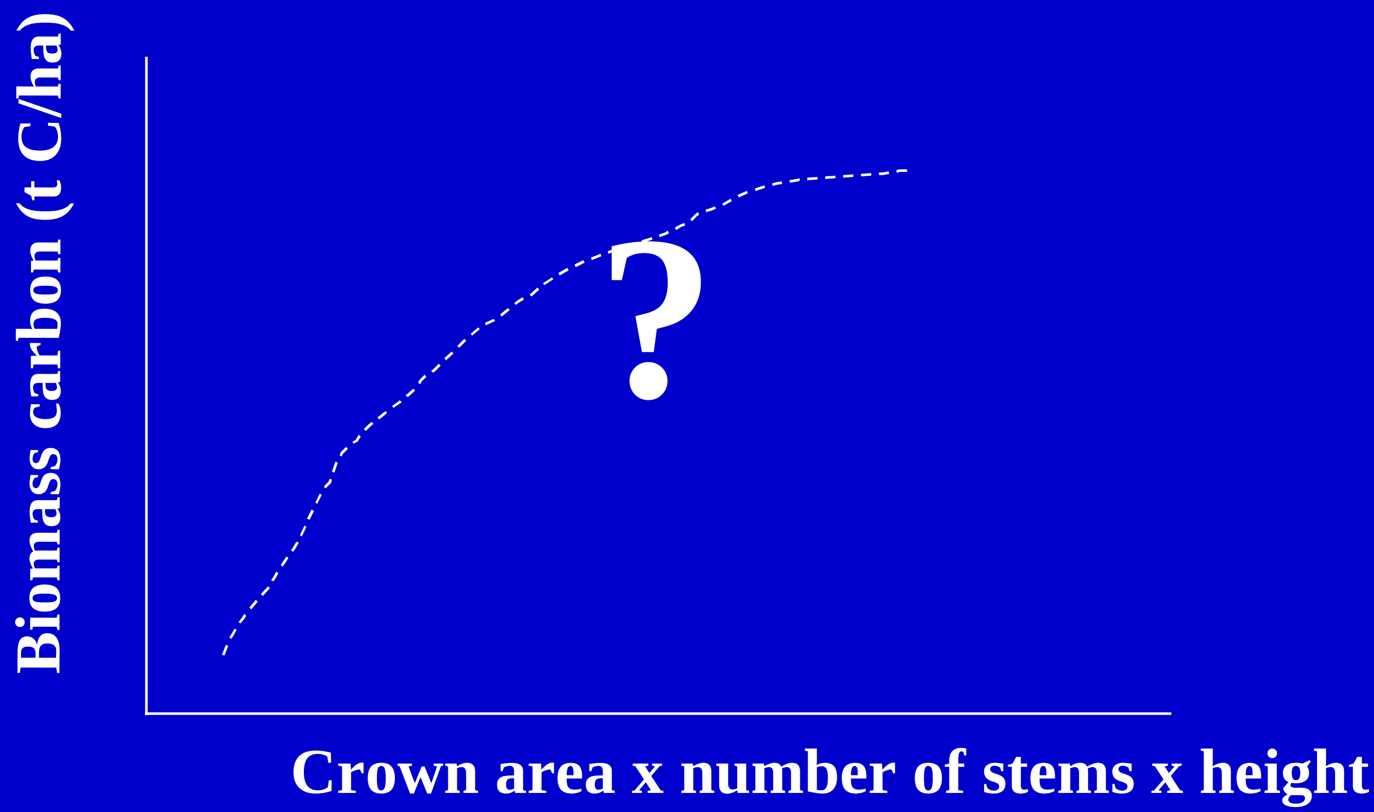
TASK 2

Comparing Advanced Videography to Ground Plots

Establishing permanent plots after areas have been identified by advanced videography for measurement.

TASK 2

Develop Regressions by Correlating Videography Data with Permanent Plot Carbon Inventories



TASK 2

Preliminary Results

- For the mixed liana forest strata in the Noel Kempff project:
  - from ground plots—carbon in trees is 89.6 t/ha, 95% confidence interval of 8.7% of the mean
  - from videography plots—carbon in trees is 87.7 t/ha, 95% confidence interval of 7.3% of the mean

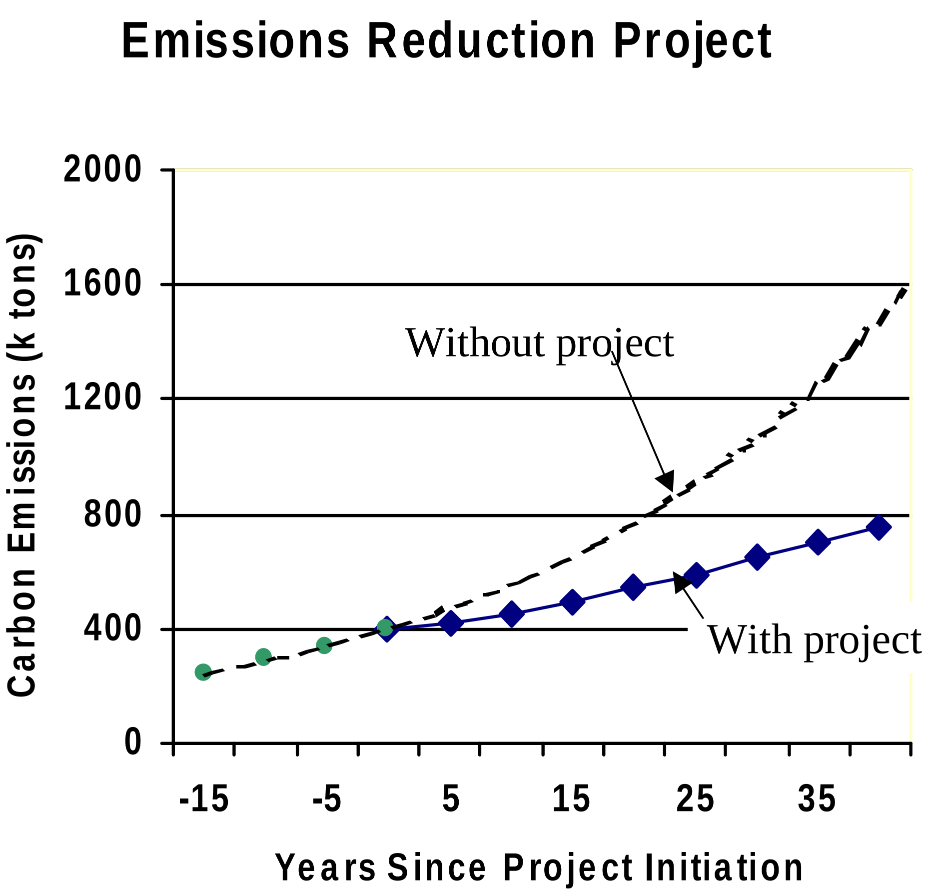
Strengths of Advanced Videography

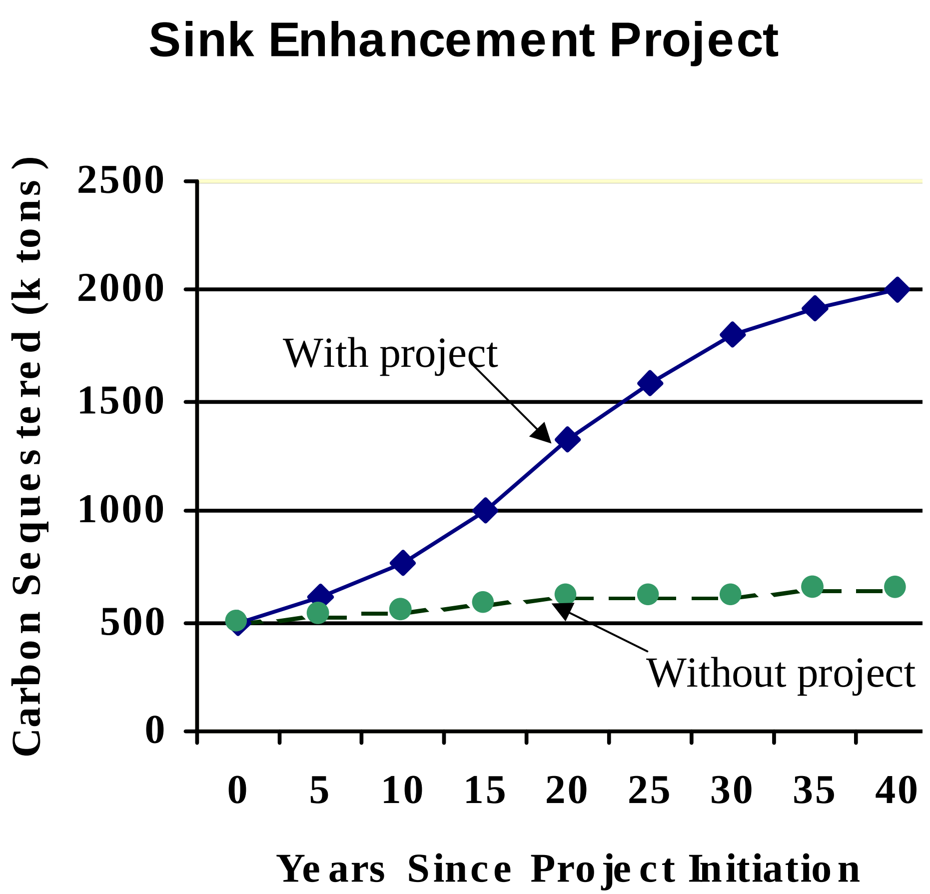
- Easy to cover large areas to improve stratification and reduce sampling error
- Measurement possible in difficult areas (e.g. Rio Bravo pine savanna)
- Decreased costs?

Task 3

- Baselines/Land Use Trend Models
  - A carbon storage baseline against which project carbon storage is measured.
  - Studies in Brazil, Chile, Florida, [Ohio, North Carolina, Washington]

Measuring Offsets





Measuring Offsets

COMPARE

With Project Case

- Preserved Natural Forest

Without Project Case aka Baseline Case

- Land Conversion

PROCEDURES

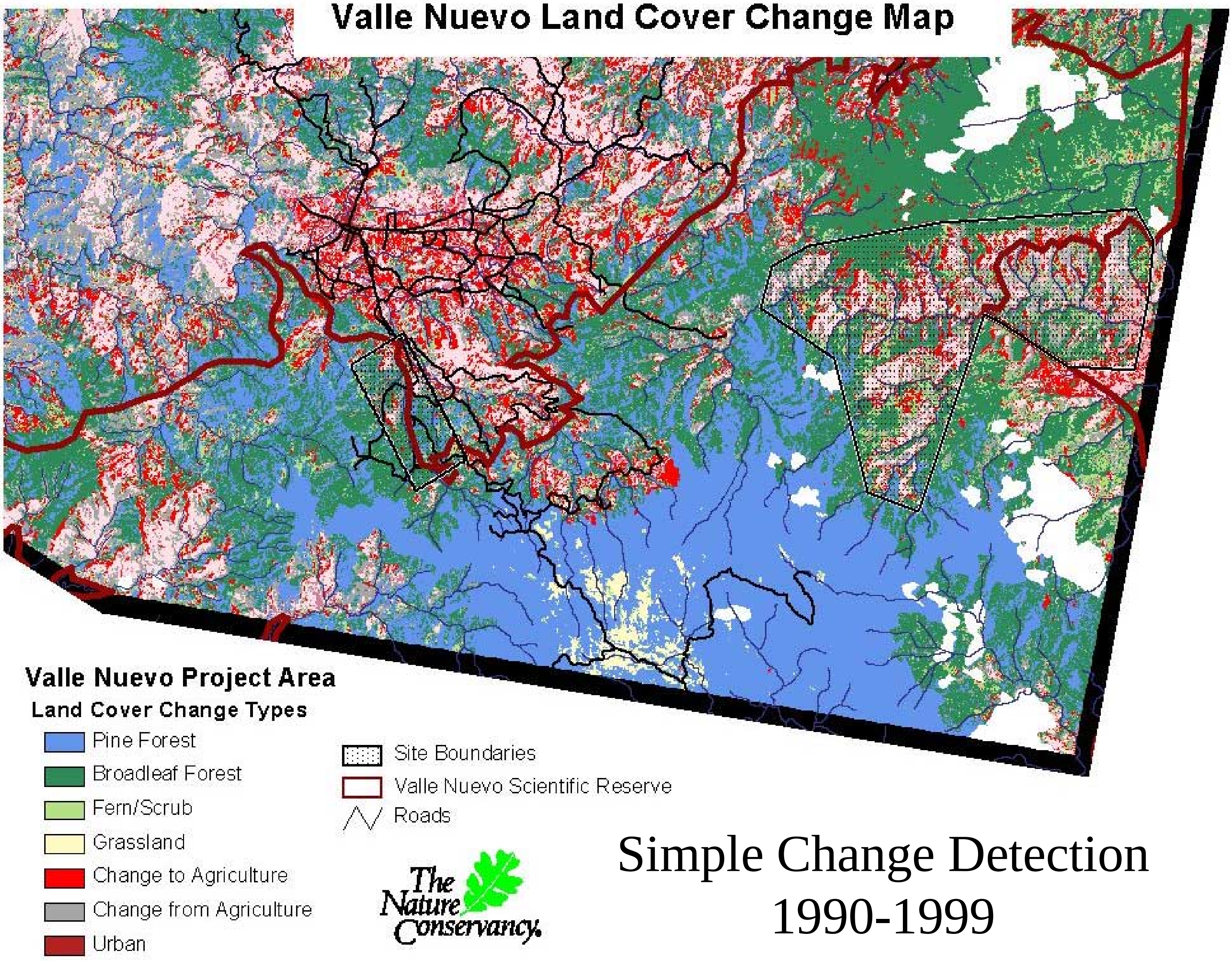
- Permanent plot inventories of carbon
- Infrequent monitoring

- **Estimate future conversion rate (historical data, trends from reference areas)**
- Permanent plot inventories of carbon in agriculture and/or other baseline systems

TASK 3

Baselines: Projections of Land Use Trends

- Projecting changes in land use is difficult because of dynamic socio-economic, cultural, and political conditions.
- Method needs to be credible, objective, and replicable.
- For these types of projects we are currently conducting our own assessments using empirical data (change detection).

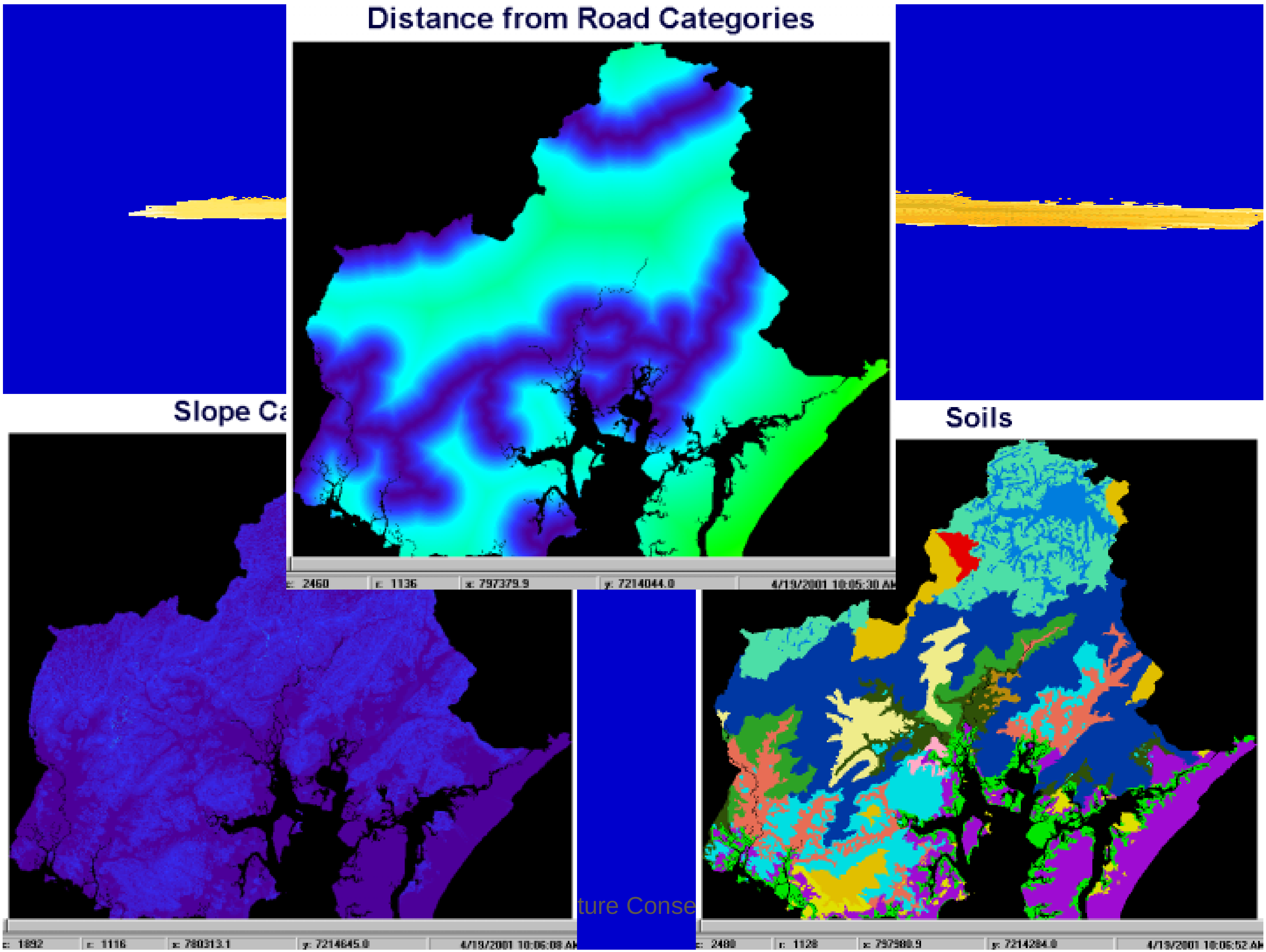


Simple Change Detection
1990-1999

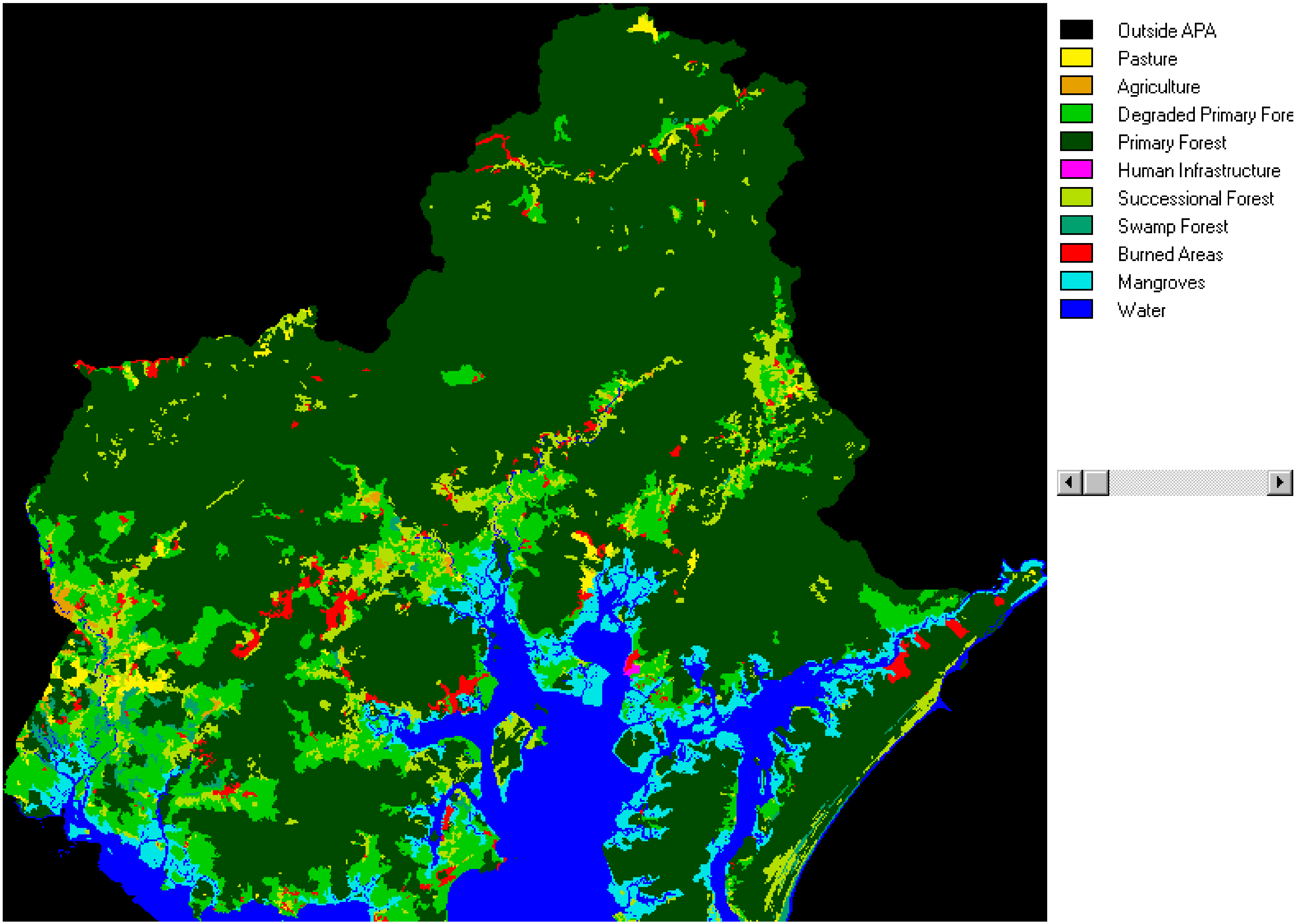
GEOMOD Goes a Few Steps Further

What factors have influenced human land use decision making over time???

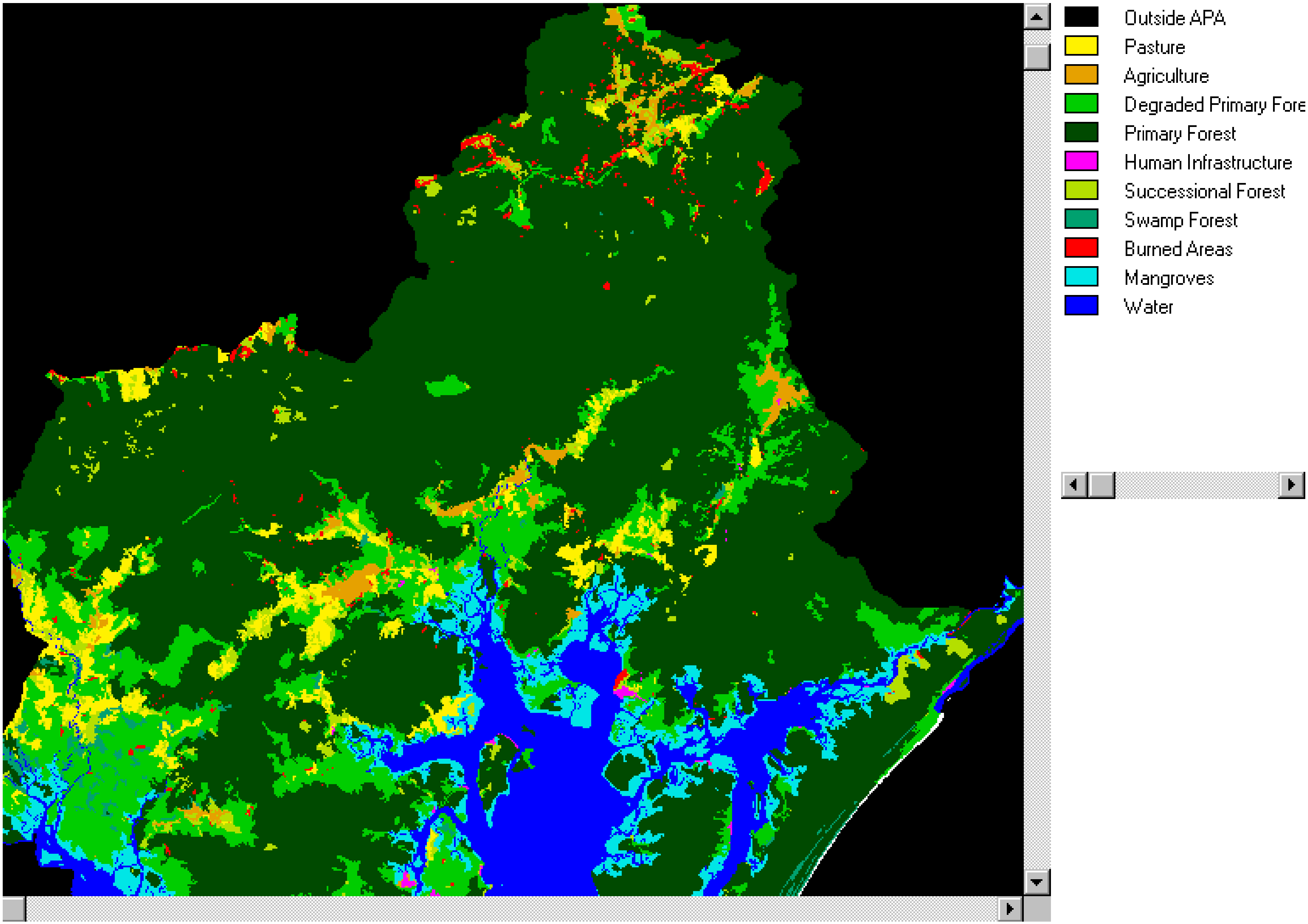
Has land clearing occurred more as a function of slope, distance from roads, distance from settlements, what?


Distance from Road Categories
Slope Ca
Soils
c: 2460
r: 1136
x: 797379.9
y: 7214044.0
4/19/2001 10:05:30 AM
c: 1892
r: 1116
x: 780313.1
y: 7214645.0
4/19/2001 10:06:08 AM
ture Conse
c: 2480
r: 1128
x: 797980.9
y: 7214204.0
4/19/2001 10:06:52 AM

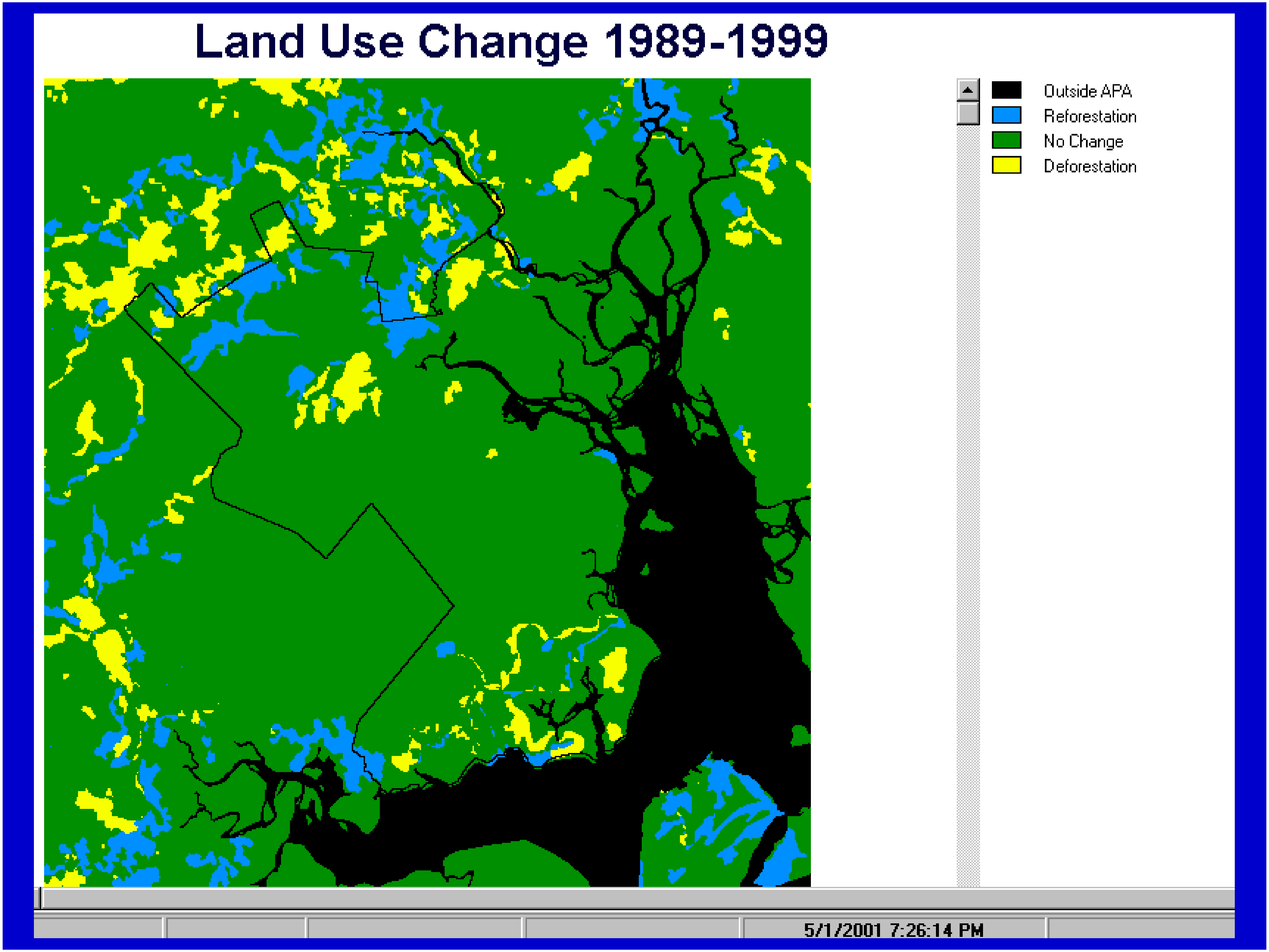
1989 Land Use/Cover



1999 Land Use/Cover



Land Use Change 1989-1999



Preliminary Results for Brazil

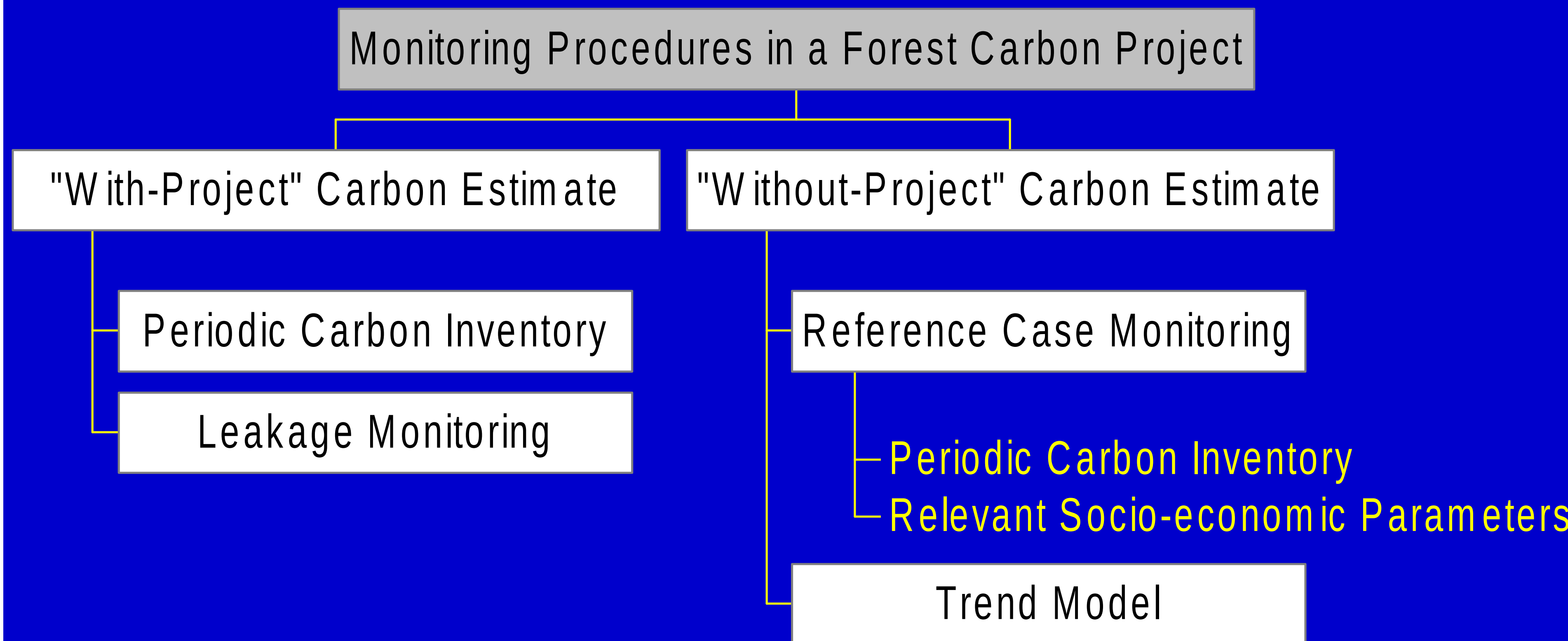
Weights for each driver are as follows:

Elevation	76.0
Aspect	77.9
Slope	82.1
Distance from Rivers	56.6
Distance from Roads	59.3
Distance from Communities	58.6
Soils	70.8
1994 Vegetation	39.8
Distance from Navigable Water	70.6

Task 4

- Technical Advisory Panel
  - Annual internal and external QA/QC of methodologies and ongoing research.
  - Decisions on standardization of approaches (e.g carbon inventory and baseline approaches).
  - Opportunities for outreach.
  - Exploration of issues such as leakage.
  - Policy relevant dialogue and publications.

Methods and Procedures Up for TAP Review



TASK 4

Task 5

- Seven Domestic Feasibility Studies
  - Analyze feasibility of a variety of general project ideas that have positive biodiversity effects.
  - Gather basic carbon and cost information.
  - Assess opportunities for combining carbon funding with other sources of funding to make projects more attractive.

Feasibility Studies

- Proposed Studies
  - Arizona and Indiana Grassland Restoration
  - Abandoned Mined Land Restoration in Virginia
  - Riparian Forest Restoration in Pennsylvania
  - Riparian Forest Restoration in Illinois
  - Bottomland Hardwood Forest Restoration in the MS Delta
  - Long Leaf Pine Forest Protection and Restoration in Florida

TASK 5

Task 6

- Screening Models for Project Ideas in the U.S.
  - Uses existing data, and data gathered through the feasibility studies.
  - Provides quick and easy screening of carbon project ideas.

Conclusion

- This work will greatly improve the planning, design, and implementation of carbon sequestration projects, and will help to standardize approaches.
- *Planning : Spreadsheet model and baseline studies*
- *Design: Feasibility and baseline studies*
- *Implementation: Carbon inventory advances and advanced videography*
- *Standardization: Technical Advisory Panel*